CLAIMS

Please cancel claims 9, 15, 27, 30, 42, 47, 50, 56, 61-76, and 78-81 without prejudice or disclaimer. Please also amend the claims and add new claims as shown in the following claim listing:

1.   (Currently amended) A memory system, comprising:

~~a hard disk;~~

a non-volatile cache memory~~, wherein the cache memory is comprised of a non-volatile ferroelectric memory~~;

a memory controller, operable to:

determine if a memory request received by the memory system can be satisfied by accessing the non-volatile cache memory;

queue ~~up~~ the memory request if the memory request cannot be satisfied by the non-volatile cache memory; and

execute the queued memory request ~~queued up~~ when ~~the~~ a hard disk is accessed in response to a read memory request.

2.   (Currently amended) The system of claim 1, wherein the non-volatile cache memory ~~further~~ comprises a ~~polymer~~ ferroelectric memory.

3.   (Currently amended) The system of claim 1, wherein the memory controller ~~further~~ comprises a digital signal processor.

4.   (Currently amended) The system of claim 1, wherein the memory controller ~~further~~ comprises an application specific integrated circuit.

5.   (Currently amended) The system of claim 1, wherein the memory controller ~~further~~ comprises software running on a host processor.

6.   (Currently amended) The system of claim 1, wherein the memory controller resides coincident with the <u>non-volatile</u> cache memory.

7.   (Currently amended) The system of claim 1, wherein the memory controller resides separately from both the <u>non-volatile</u> cache memory and the hard disk.

8.   (Currently amended) A method ~~of processing memory requests, the method~~ comprising:

   receiving a request for a memory <u>read</u> operation;

   determining if data for the memory <u>read</u> operation exists in a ~~ferroelectric~~ <u>non-volatile</u> cache memory;

      if the data does not exist in the ~~ferroelectric~~ <u>non-volatile</u> cache memory:

         accessing a hard disk that contains ~~the~~ data for the request; and

         performing ~~any~~ <u>one or more</u> queued ~~up~~ disk memory operations <u>in response to the request</u>.

9.   (Canceled).

10.   (Currently amended) The method of claim 8, wherein accessing a hard disk ~~further~~ comprises spinning up the hard disk.

11.   (Currently amended) The method of claim 10, ~~the method further~~ comprising spinning down the hard disk after performing ~~any~~ <u>one or more</u> queued ~~up~~ disk memory operations.

12.   (Currently amended) The method of claim 8, wherein if the data does not exist in the ~~ferroelectric~~ <u>non-volatile</u> cache memory~~, the method further comprising~~:

   determining if the request is part of a sequential stream;

if the request is part of a sequential stream, deallocating cache lines in the non-volatile cache memory and prefetching new cache lines;

if request is not part of a sequential stream, determine if prefetch is desirable; and

if prefetch is desirable, prefetch data.

13. (Currently amended) The method of claim ~~12~~ 8, wherein ~~the prefetch is queued up as a disk memory operation~~ performing one or more queued disk memory operations comprises performing a prefetch operation.

14. (Currently amended) The method of claim 8, wherein performing ~~any~~ one or more queued ~~up~~ disk memory operations ~~further~~ comprises determining if ~~the~~ any queued ~~up~~ disk memory operations are desirable and then performing ~~the~~ any queued ~~up~~ disk memory operations that are desirable.

15. (Canceled).

16. (Currently amended) The method of claim 8, ~~further~~ comprising:

receiving a request for a memory write operation;

determining if data for the memory write operation exists in the non-volatile cache memory; and

writing data into the non-volatile cache memory if ~~the~~ data for the memory write operation exists in the ~~ferroelectric~~ non-volatile cache memory.

17. (Currently amended) The method of claim 16, ~~further~~ comprising queuing ~~up~~ a disk memory operation and transferring ~~the~~ data to the hard disk from the ~~ferroelectric~~ non-volatile cache memory after ~~the~~ accessing the hard disk.

18.   (Currently amended) The method of claim 8, wherein ~~the~~ queued ~~up~~ disk memory operations are periodically reviewed to ensure their continued desirability.

19.   (Currently amended) The method of claim ~~8, further~~ 16 comprising performing a disk memory operation if ~~the~~ data for the memory write operation does not exist in the ~~ferroelectric~~ non-volatile cache memory, ~~and~~ wherein the disk memory operation ~~further~~ comprises ~~writing~~ a write operation to write data to the hard disk.

20.   (Currently amended) The method of claim 8, wherein ~~the queued up disk memory operations include writing~~ performing one or more queued disk memory operations comprises performing a write operation to write data from the ~~ferroelectric~~ non-volatile cache memory to the hard disk.

21.   (Currently amended) A method ~~of performing a read memory operation, the method~~ comprising:

    receiving a read request;

    determining if data to satisfy the read request is located in a ~~ferroelectric~~ non-volatile cache;

    satisfying the read request from data in the ~~ferroelectric~~ non-volatile cache, if the data is located in the ~~ferroelectric~~ non-volatile cache;

    if the data is not located in the ~~ferroelectric~~ non-volatile cache, performing a disk read operation, wherein the disk read operation comprises:

        accessing a disk;

        allocating a new cache line;

        transferring data from the disk to the new cache line; and

        satisfying the read request; and

    performing one or more queued disk memory operations in response to the disk read operation.

22. (Currently amended) The method of claim 21, wherein accessing a disk ~~further~~ comprises spinning up a hard disk.

23. (Currently amended) The method of claim 22, ~~wherein the method further comprises~~ comprising spinning down the hard disk after satisfying the read request and performing one or more queued disk memory operations.

24. (Currently amended) The method of claim 21, wherein the disk read operation ~~further~~ comprises:

determining if the data transferred from the disk to the new cache line is part of a sequential stream;

if the data is part of a sequential stream, prefetching new cache lines~~;~~

~~if the data is not part of a sequential stream, determining if prefetch is desirable; and~~

~~if prefetching is desirable, performing a prefetch.~~

25. (Currently amended) The method of claim ~~24, wherein prefetching further comprises queuing up~~ 21, wherein performing one or more queued disk memory operations comprises performing a prefetch operation ~~to be executed during a next disk memory operation.~~

26. (Currently amended) A method ~~of performing a write memory request, the method~~ comprising:

receiving a write request;

determining if at least one line in a ~~ferroelectric~~ non-volatile cache is associated with the write request;

if at least one line in the ~~ferroelectric~~ non-volatile cache is associated with the write request, performing a cache write to the line; and

if no lines in the ~~ferroelectric~~ non-volatile cache are associated with the write request, performing a ~~new~~ write operation <u>comprising allocating a new cache line, writing data for the write request to the allocated line, and queuing a disk write operation to transfer the data from the non-volatile cache to a disk in response to a read operation.</u>

27.   (Canceled).

28.   (Currently amended) An apparatus comprising:
     a non-volatile ~~polymer ferroelectric~~ cache memory ~~coupled to a storage device~~<u>; and</u>
     <u>a controller to queue a memory request and to execute the queued memory request when a storage device is accessed in response to a read request</u>.

29.   (Currently amended) The apparatus of claim 28 ~~further comprising a controller coupled to the non-volatile polymer ferroelectric cache to queue a memory request and~~ wherein the storage device includes a part capable of moving.

30.   (Canceled).

31.   (Previously presented) The apparatus of claim 29 wherein the controller is adapted to queue the memory request while the part is not moving.

32.   (Currently amended) The apparatus of claim ~~29~~ <u>28</u> wherein the controller comprises software.

33.   (Currently amended) The apparatus of claim 32 ~~wherein the apparatus further comprises~~ <u>comprising</u> a general-purpose processor ~~coupled to the non-volatile polymer ferroelectric cache memory, and~~ <u>wherein</u> the software comprises a driver for execution by the general-purpose processor.

34.   (Currently amended) The apparatus of claim 28 ~~wherein the apparatus comprises~~ comprising a system selected from the group comprising a personal computer, a server, a workstation, a router, a switch, ~~and~~ a network appliance, a handheld computer, an instant messaging device, a pager and a mobile telephone.

35.   (Currently amended) The apparatus of claim ~~30~~ 28 wherein the controller comprises a hardware controller device.

36.   (Previously presented) The apparatus of claim 28 wherein the storage device comprises a rotating storage device.

37.   (Previously presented) The apparatus of claim 36 wherein the rotating storage device comprises a hard disk drive.

38-39. (Canceled).

40.   (Currently amended) An apparatus comprising:
        a rotating storage device;
        a non-volatile ~~ferroelectric~~ cache memory ~~coupled to the rotating storage device~~; and
        a controller coupled to the non-volatile cache memory and capable of:
                queuing first access requests directed to the rotating storage device;
                spinning up the rotating storage device in response to a second access ~~requests~~ request, wherein the second access request is a read request; and
                completing ~~the~~ queued first access requests ~~after the rotating storage device is spun up~~ in response to the second access request.

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41.   (Previously presented) The apparatus of claim 40 wherein the first access requests comprise write requests.

42.   (Canceled).

43.   (Currently amended) The apparatus of ~~claim 42~~ claim 40 wherein the ~~read requests comprise read requests for which there is~~ controller is to spin up the rotating storage device in response to a miss by the non-volatile ~~ferroelectric~~ cache memory.

44.   (Currently amended) The apparatus of ~~claim 41~~ claim 40 wherein the first access requests ~~further~~ comprise ~~prefetches~~ prefetch requests.

45.   (Currently amended) The apparatus of claim 44 wherein the ~~read requests comprise read requests for which there is~~ controller is to spin up the rotating storage device in response to a miss by the non-volatile ~~ferroelectric~~ cache memory.

46.   (Currently amended) A method of operating a system which includes a rotating storage device, the method comprising:
        spinning down the rotating storage device;
        receiving a first access request directed to the storage device;
        queuing ~~up~~ the first access request ~~using a ferroelectric memory~~;
        receiving a second access request directed to the storage device, wherein the second
access request is a read request; and
        in response to receiving the second access request, spinning up the rotating storage
~~device; and~~ device and servicing the second access request and the queued first access request.

47.   (Canceled).

48.   (Currently amended) The method of ~~claim 47~~ claim 46 wherein the system includes a cache and the second access request ~~comprises a read request that~~ misses the cache.

49.   (Currently amended) The method of ~~claim 47~~ claim 46 wherein the servicing of the queued first access request is performed after the servicing of the second access request.

50.   (Canceled).

51.   (Currently amended) The method of claim ~~50~~ 46 wherein the system includes a cache and queuing ~~up~~ the first access request comprises recording the first access request in the cache.

52.   (Previously presented) A method, comprising:
        writing data from a non-volatile cache memory to store in a disk memory in response to a cache read miss.

53.   (Previously presented) The method of claim 52, further comprising reviewing the data in the non-volatile cache memory to determine if the data is desirable to store in the disk memory.

54.   (Previously presented) The method of claim 52, wherein the writing comprises writing the data from a non-volatile polymer ferroelectric cache memory to the disk memory in response to the cache read miss.

55.   (Currently amended) A method, comprising:
        writing data from a polymer cache memory to a disk memory in response to a cache read miss and after receiving a write request.

56.   (Canceled).

57.   (Currently amended) The method of claim 55, ~~further comprises~~ <u>comprising</u>:

receiving at least two write requests prior to the writing; and

writing data associated with the at least two write requests to the disk memory from the polymer cache memory after a cache read miss.

58.   (Previously presented) A method, comprising:

receiving at least two write requests to write data to a disk memory; and

writing the data associated with the at least two write requests to the disk memory in response to a cache read miss.

59.   (Previously presented) The method of claim 58, further comprising:

storing the data associated with the at least two write requests in a non-volatile polymer cache memory prior to the writing.

60.   (Currently amended) The method of claim ~~59~~ <u>58,</u> wherein the at least two write requests are received when the disk memory is spun down, and ~~further comprising~~ <u>wherein the method comprises</u> spinning up the disk memory in response to the cache read miss.

61-76. (Canceled).

77.   (Previously presented) The method of claim 58, further comprising:

storing the data associated with the at least two write requests in a non-volatile ferroelectric cache memory prior to the writing.

78-81. (Canceled).

82.   (Currently amended) The apparatus of claim ~~80~~ <u>28,</u> wherein the non-volatile cache memory is a ~~polymer~~ ferroelectric memory.

83.   (Currently amended) The apparatus of claim 80 28, wherein the non-volatile cache memory includes at least one layer of polymer material between at least two electrodes.

84.   (Previously presented) The apparatus of claim 83, wherein the polymer material is a polymer material having ferroelectric properties.

85.   (New) The memory system of claim 1, wherein the queued memory request comprises a write request.

86.   (New) The memory system of claim 1, wherein the queued memory request comprises a prefetch request.

87.   (New) The memory system of claim 1, wherein the memory controller is operable to execute the queued memory request when a hard disk is accessed in response to a cache miss for the read memory request.

88.   (New) The memory system of claim 1, wherein the non-volatile cache memory comprises a polymer memory.

89.   (New) The method of claim 8, wherein if the data does not exist in the non-volatile cache memory:
        determining if prefetch is desirable; and
        if prefetch is desirable, prefetching data.

90.   (New) The method of claim 8, wherein determining if data for the memory read operation exists in a non-volatile cache memory comprises determining if data for the memory read operation exists in a ferroelectric cache memory.

91. (New) The method of claim 8, wherein determining if data for the memory read operation exists in a non-volatile cache memory comprises determining if data for the memory read operation exists in a polymer cache memory.

92. (New) The method of claim 21, wherein the disk read operation comprises:
determining if prefetch is desirable; and
if prefetch is desirable, performing a prefetch.

93. (New) The method of claim 21, wherein performing one or more queued disk memory operations comprises performing a write operation.

94. (New) The method of claim 21, wherein determining if data to satisfy the read request is located in a non-volatile cache comprises determining if data to satisfy the read request is located in a ferroelectric cache.

95. (New) The method of claim 21, wherein determining if data to satisfy the read request is located in a non-volatile cache comprises determining if data to satisfy the read request is located in a polymer cache.

96. (New) The method of claim 26, wherein queuing a disk write operation comprises queuing a disk write operation to transfer the data from the non-volatile cache to a disk in response to a read operation resulting from a cache miss.

97. (New) The method of claim 26, wherein determining if at least one line in a non-volatile cache is associated with the write request comprises determining if at least one line in a ferroelectric cache is associated with the write request.

98. (New) The method of claim 26, wherein determining if at least one line in a non-volatile cache is associated with the write request comprises determining if at least one line in a polymer cache is associated with the write request.

99. (New) The apparatus of claim 28, wherein the queued memory request comprises a write request.

100. (New) The apparatus of claim 28, wherein the queued memory request comprises a prefetch request.

101. (New) The apparatus of claim 28, wherein the controller is to execute the queued memory request when a storage device is accessed in response to a cache miss for the read request.

102. (New) The apparatus of claim 40, wherein the non-volatile cache memory comprises ferroelectric memory.

103. (New) The apparatus of claim 40, wherein the non-volatile cache memory comprises polymer memory.

104. (New) The method of claim 46, wherein the first access request comprises a prefetch request.

105. (New) The method of claim 48, wherein the cache comprises ferroelectric memory.

106. (New) The method of claim 48, wherein the cache comprises polymer memory.